# DLP® Pico™ Technology for Screenless Display

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## Contents



## List of Figures

# What is DLP® Pico™ Technology?

Texas Instruments DLP Pico technology is a micro-electro-mechanical systems (MEMS) technology that modulates light using a digital micromirror device (DMD). A DMD consists of hundreds of thousands of highly reflective, digitally switchable, micrometer-sized mirrors (micromirrors) organized in a two-dimensional array.

Each micromirror on a DMD represents a pixel on the screen **(Figure 1)** and is independently modulated, in sync with color sequential illumination, to create stunning displays. DLP Pico technology powers the displays of products worldwide, from media projectors to projectors inside of tablets and smartphones. TI's DLP Pico chipsets are a great fit for any display system that requires high resolution and high brightness at low power in a compact size.

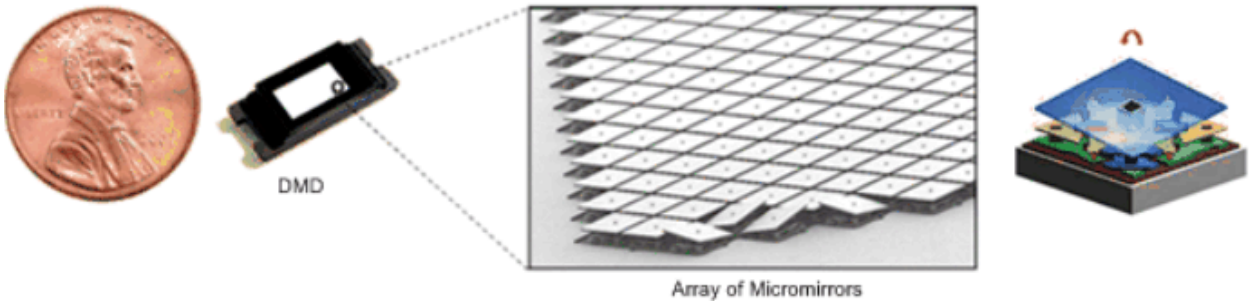


***Figure 1.*** *Digital Micromirror Device (DMD)*

## What is Screenless Display?

Screenless Display is a new class of projection-based display device that combines the latest innovations across three technology areas: DLP Pico technology, wireless connectivity and any mobile operating system (**Figure 2**). By combining these three technologies, Screenless Display allows users to display any content on virtually any surface from a small, portable wireless device. For example, the display surface can be a wall or table in an office or a home, a kitchen counter-top, the ceiling in a bedroom, the side of a camping tent, or even a garage door (**Figure 3**).

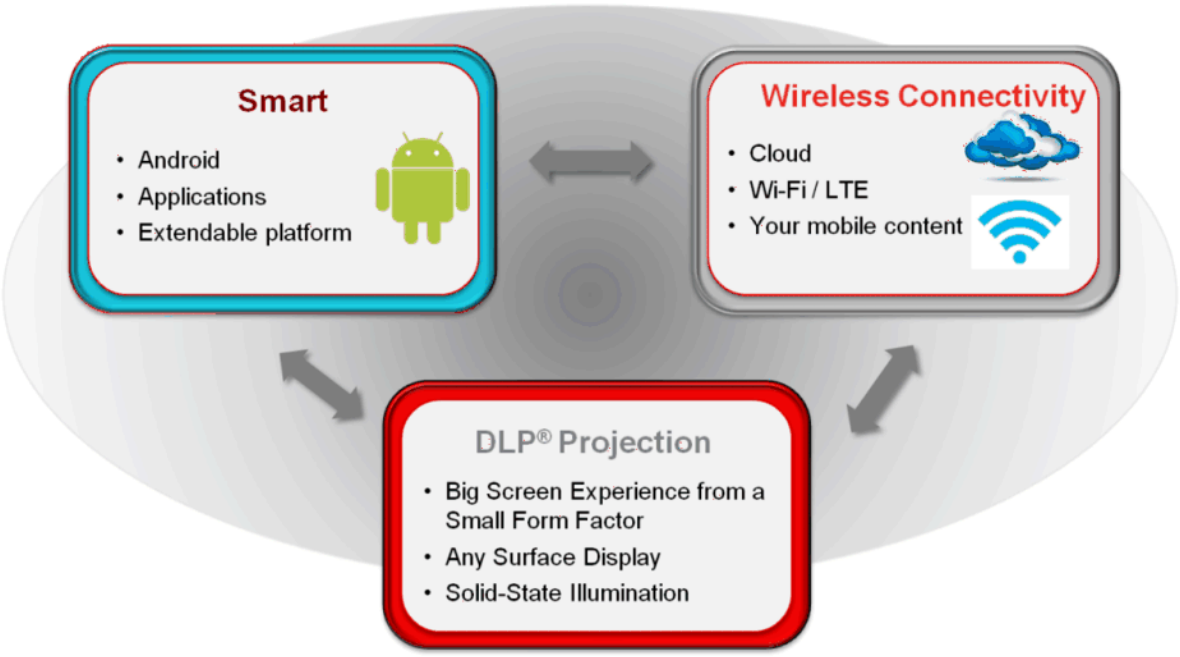


***Figure 2.*** *Screenless Display as Combination of Three Technologies*

Screenless Display can be used in a wide variety of ways. Some possible use cases are:

- On the go display: For consumers who travel frequently or live in small homes, Screenless Display with embedded wireless and video streaming applications can create a large display when needed yet also remain extremely portable.
- Anywhere display: For consumers who would rather not have a TV mounted on a bedroom wall, a Screenless Display can be an inconspicuous wireless device that blends in to the décor while creating a large, HD display on a wall or a ceiling as required.
- Portable cinema: For consumers who like to share video experiences with others, a Screenless Display can create unique group viewing opportunities on virtually any surface, inside or outside. For example, a big game on the garage door, a movie night in the backyard, or watching a movie on the side of a tent while camping.

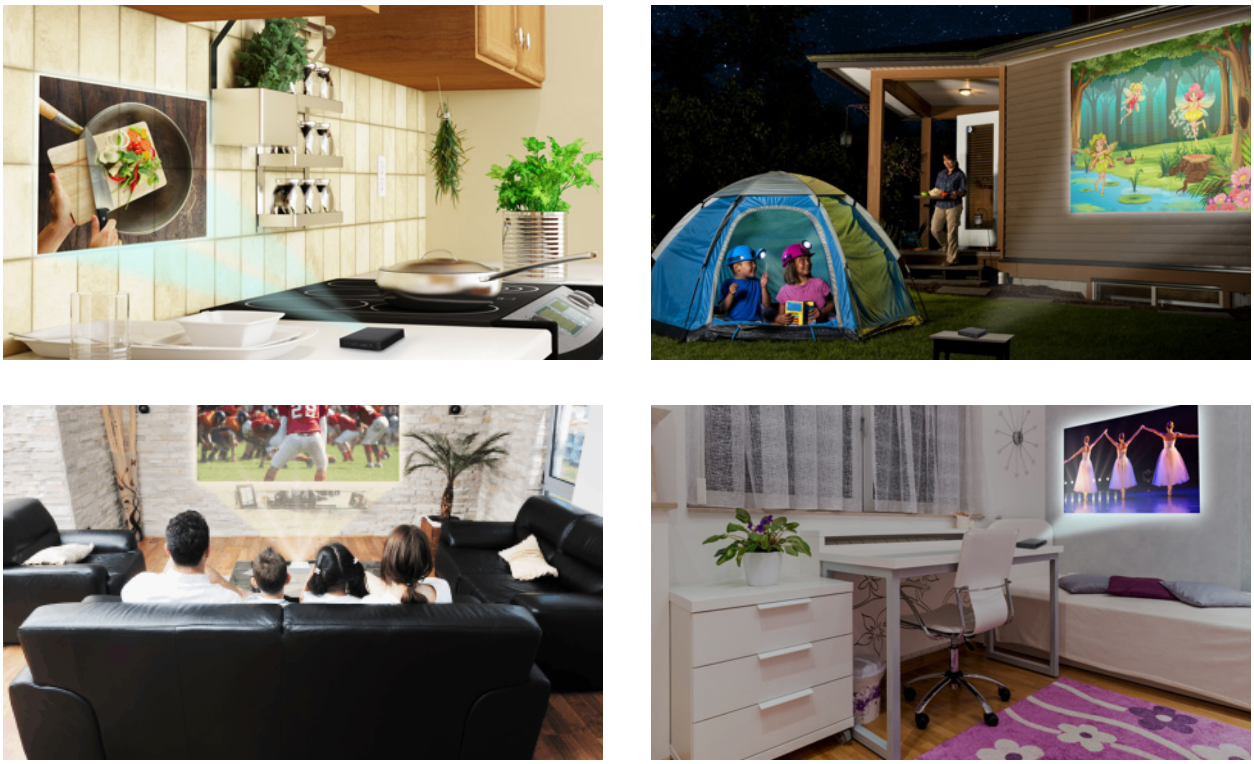

***Figure 3.*** *Screenless Display Examples*

## Screenless Display Advantages over Traditional Displays

Screenless Display has several key advantages over traditional displays:

- Screenless – No fixed screen or display panel required, allowing content to be displayed on virtually any surface.
- Portable – No fixed installation required, enabling Screenless Display product to be easily moved or taken on the go. In contrast, traditional big screen televisions are large and not easily moved or transported.
- Scalable – The display image size scales with distance from the display surface, enabling images ranging from as small as few inches in diagonal to as large as 100 inches or more in diagonal from the same portable device.
- Quick Set Up – No fixed installation or mounting on the wall or placement on a pedestal required – allowing Screenless Display product to just power on and create stunning display.
- Improved Aesthetics – No fixed screen required, allowing display to be only visible when required and invisible when turned off. Once the display is off, the room aesthetics are kept in its natural state —without compromise—so there is no display panel to view “all of the time”.
- Small Size – No large display panel required, allowing Screenless Display product to be small size—can be designed to fit in your pocket or carry in your hand.
- Smart – Built-in video streaming applications and Wi-Fi, enabling Screenless Display product to provide all functionalities of a smart display.

## Why Choose DLP Pico Technology for Screenless Display?

DLP Pico technology offers several key advantages that make it a great fit for Screenless Display:

- High optical efficiency: DLP Pico technology can work with any light source including LEDs, lasers, laser-phosphor or lamp and offers very high optical efficiency. The result is a high brightness display with low power consumption, which is a particularly good fit for high brightness display applications such as Screenless Display. Low power consumption also enables battery operation for a cable-less experience.
- Wide choice of display resolution chipsets: DLP Pico technology offers a wide range of display chipsets ranging from small resolution – nHD (640 × 360), WVGA (854 × 480) to HD resolution – WXGA (1280 × 800), HD (1280 × 720) and Full HD (1920 × 1080) resolutions. This provides the system designer with flexibility in designing and differentiating products across brightness, size, resolution, battery requirements and cost levels.
- High contrast: Depending on the optical design, DLP Pico technology can enable a high contrast ratio, which creates deep blacks and improves perceived brightness and image quality.
- High speed: Each DMD micromirror can flip thousands of times per second, enabling fast color refresh rates and high frame rates (120 Hz or higher in select cases). In addition, low display latency makes DLP Pico technology a great fit for gaming.
- Advanced image processing algorithms: The DLP® IntelliBright™ suite of algorithms provides two key functions:
  - Content Adaptive Illumination Control: The ability to dynamically adjust each RGB LED to optimize power based on frame by frame content.
  - Local Area Brightness Boost: The ability to intelligently boost darker regions of images depending on ambient lighting conditions. For more information on these algorithms, see the TI DLP **IntelliBright** application note.

DLP Pico technology is a proven display technology. Tens of millions of DLP chips have been sold and DLP Cinema® is the technology of choice for more than eight of ten digital cinema screens worldwide. DLP chipsets for Screenless Display take the same core technology and transform it into a tiny chip that creates stunning displays from compact, portable devices.

## System and Electronics Considerations for Screenless Display Using DLP Technology

A typical Screenless Display system is comprised of two subsystems (**Figure 4**):

- Front end subsystem
- DLP Pico Projection subsystem

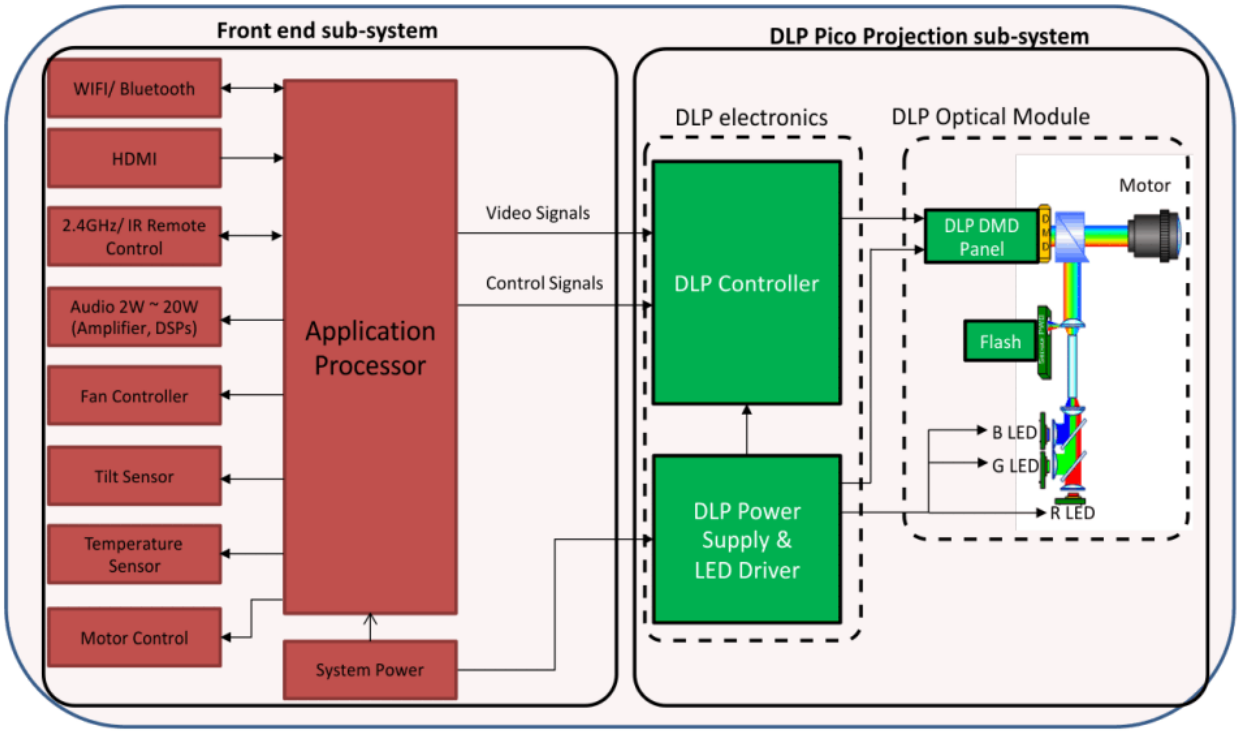


***Figure 4.*** *Screenless Display System Diagram*

## Front end subsystem

Consists of an application processor that provides functionality such as:

- Wi-Fi/Bluetooth
- HDMI
- IR remote control
- Audio control
- Fan control
- Tilt sensor for automatic keystone correction
- Motor control for autofocus

## DLP Pico Projection subsystem

The DLP Pico Projection subsystem consists of two additional subsystems: the DLP Pico optical module and DLP Pico electronics.

### DLP Pico Optical Module

The DLP Pico DMD, along with its associated illumination sources, optical elements, and necessary mechanical components are combined into a compact and rugged assembly known as an optical module or light engine (**Figure 5**).

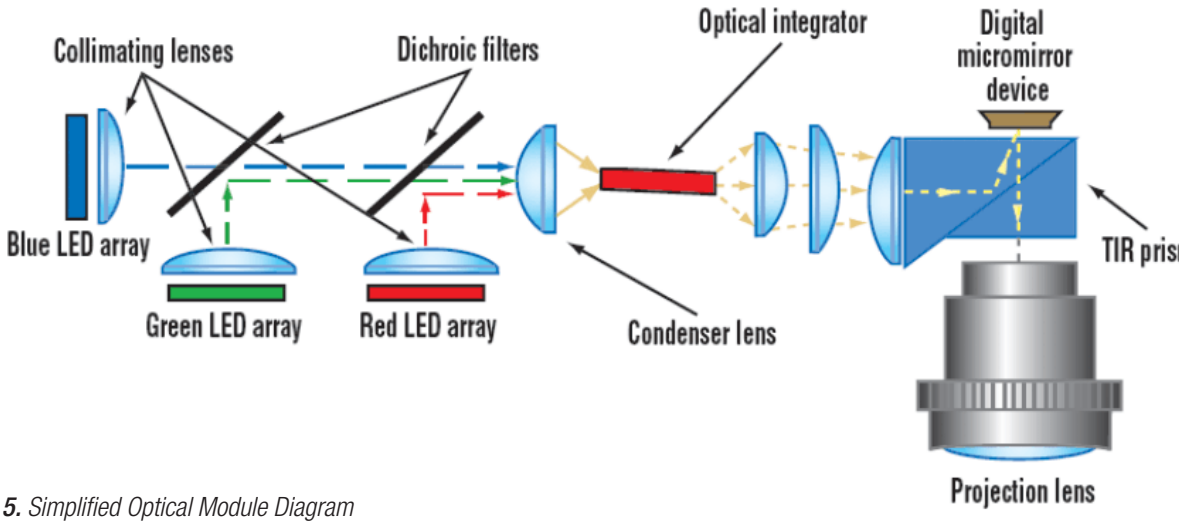


***Figure 5.*** *Simplified Optical Module Diagram*

The optical module is the core display component of the system. Optical modules can be of various sizes depending on the application and requirements. In general, the higher the brightness, the larger the size of the optical module due to larger LEDs, optics, DMD and thermal management in the form of heat sinks and fans.

To enable faster time to market many DLP Pico optical modules of various designs, sizes, capabilities, and performance are readily available from a number of Original Design Manufacturers (ODMs) who are part of the DLP Pico ecosystem. For more information on the ecosystem and ODM contacts, please visit the DLP Pico Solutions and Services page.

If none of the readily available optical modules fit the requirements, there are several DLP design houses that have the expertise to support custom optical designs.

## DLP Pico Electronics

- A typical DLP electronics system block diagram for a Screenless Display application is shown in **Figure 6.** The key components are the DLP controller, DLP chipset power management IC, and the LED drive circuit.
  - The DLP controller communicates with a front end processor via I2C and receives 24-bit RGB video data via parallel interface.
  - Power up/power down of the DLP system is controlled by the front end processor using the PROJ_ON signal.
  - The Power Management IC (PMIC)/LED driver provides all the necessary power supplies for the DLP controller and the DMD while the LED driver controls the RGB LED current.

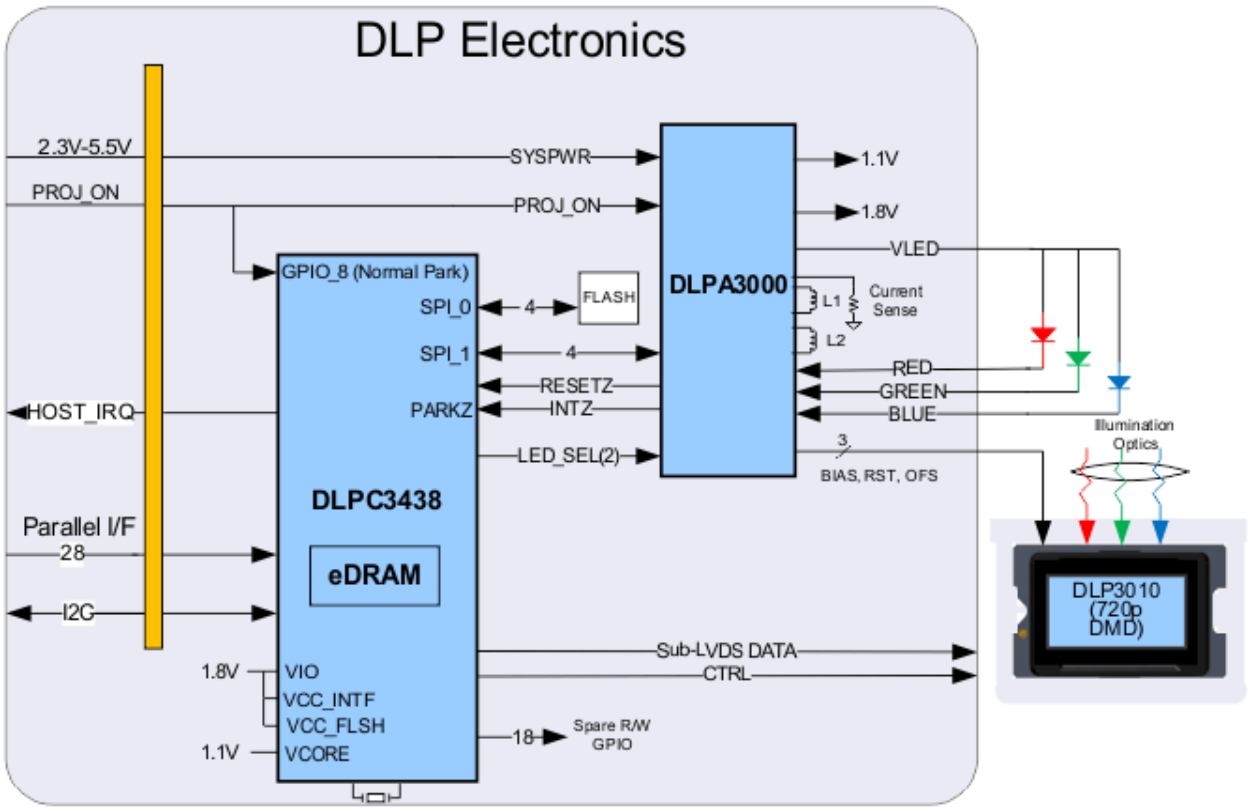


***Figure 6.*** *DLP Electronics System Block Diagram using DLP3010, DLPC3438, and DLPA3000*

## DLP Pico Chipset Portfolio for Screenless Display

The following DLP Pico chipsets are well suited for Screenless Display applications.

| DMD part number | DLP2010 | DLP230GP | DLP230KP | DLP230NP | DLP3010 | DLP3310 | DLP4710 | DLP4710 |
|---|---|---|---|---|---|---|---|---|
| **Micromirror array diagonal size(inches)** | 0.21" | 0.23" | 0.23" | 0.23" | 0.31" | 0.33" | 0.47" | 0.47" |
| **Display resolution** | 854x480 WVGA | 960x540 qHD | 1280x720 720p | 1920x1080 1080p | 1280x720 720p | 1920x1080 1080p | 1920x1080 1080p | 3840x2160 4K UHD |
| **Micromirror pitch** | 5.4µm | 5.4µm | 5.4µm | 5.4µm | 5.4µm | 5.4µm | 5.4µm | 5.4µm |
| **Micromirror orientation** | Square | Square | Square | Square | Square | Square | Square | Square |
| **Typical brightness (lumens)** | Up to 150 | Up to 200 | Up to 200 | Up to 200 | Up to 300 | Up to 400 | Up to 1500 | Up to 1500 |
| **Typical image diagonal size** | Up to 50" | Up to 60" | Up to 60" | Up to 60" | Up to 80" | Up to 80" | Up to 140" | Up to 140" |
| **Typical illumination power consumption** | 1-10W | 1-10W | 1-10W | 1-10W | 1-20W | 10-30W | 20-120W | 20-120W |
| **Optical modules in production** | Yes | Coming Soon | Yes | Coming Soon | Yes | Yes | Yes | Yes |
| **Controller part # and** | DLPC3430 DLPC3435 | DLPC3432 | DLPC3434 | DLPC3436 | DLPC3433 DLPC3438 | DLPC3437 2 required | DLPC3439 2 required | DLPC6421 2 required |
| **Frame refresh rate** | Up to 240 Hz | 120 Hz | 60 Hz | 60 Hz | Up to 120 Hz | Up to 60 Hz | Up to 60 Hz | Up to 60 Hz |
| **DLP IntelliBright™ Algorithms*** | • | • | • | • | • | • | • | • |
| **Keystone correction (1D vertical)** | • | • | • | • | • | • | | • |
| **Evaluation Module (EVM)** | Order on TI.com | | | | Order on TI.com | Order on TI.com | Order on TI.com | |
| **TI Reference Design** | TIDA-00325 | TIDA-080002 | | | TIDA-01571 | TIDA-080000 | TIDA-01226 | |
| **PMIC Part #** | | | | | | | | |
| **DLPA1000 (up to 1A)** | | | | | | | | |
| **DLPA2000 (up to 750mA)** | • | • | • | • | • | | | |
| **DLPA2005 (up to 2.4A)** | • | • | • | • | • | | | |
| **DLPA3000 (up to 6A)** | • | • | • | • | • | • | • | |
| **DLPA3005 (up to 16A)** | | | | | | | • | • |

***Figure 7.*** *Table of DLP Pico Chipset Portfolio for Screenless Display*

Brightness is an important consideration when selecting a DLP chipset. **Figure 8** can help determine the required brightness and matching chipsets based on screen size and ambient light conditions.

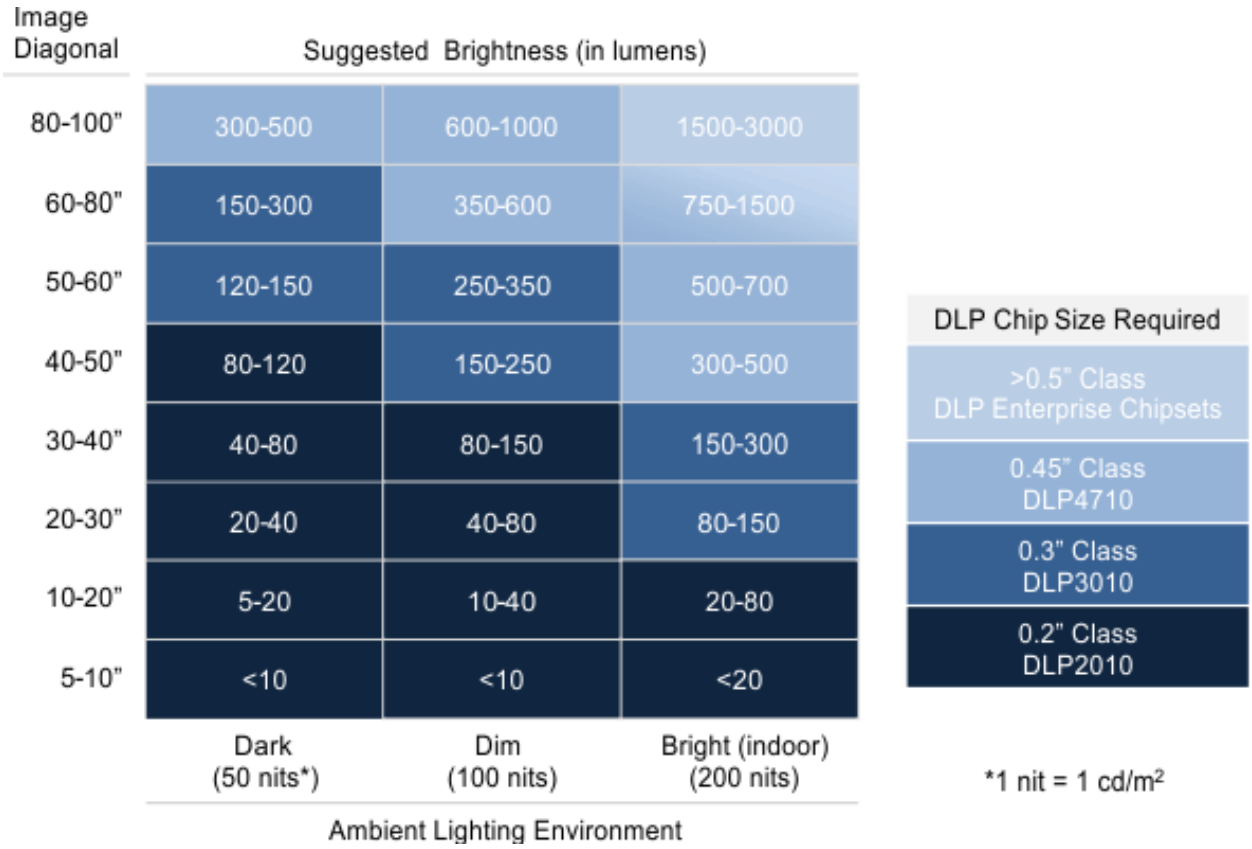


***Figure 8.*** *Brightness Table.*

***NOTE:*** *DLP Enterprise chipsets are available for >0.5 inch diagonal. Contact TI for more details.*

## Get Started with Screenless Display Product Development

**1.** Learn more about DLP Pico technology:

- Read Getting Started with TI DLP Display Technology
- Browse products and data sheets

**2.** Evaluate DLP Pico technology with an easy to use evaluation module (EVM):

- DLP2000 EVM
- DLP2010 EVM
- DLP3010 EVM
- DLP3310 EVM
- DLP4500 EVM
- DLP4710 EVM

**3.** Download a reference design to speed product development, including a schematic, layout files, BOM and test report.

- Ultra Mobile, Low Power DLP Pico qHD Display Reference Design
- DLP2010: Ultra Mobile, Ultra Low Power Display Reference Design using DLP Technology
- DLP3010: Portable, Low Power HD Projection Display using DLP Technology
- DLP3310: Mobile 1080p display reference design using DLP 0.33 inch micromirror array
- DLP4710: Portable, Low Power Full HD Projection Display using DLP Technology

**4.** Find optical modules and design support:

- Contact third party optical module manufacturers for production ready optics for your DLP design.
- Contact third party design houses for custom optical design, electronics design, software and more.

**5.** Contact your local TI salesperson or TI distributor representative: www.ti.com/general/docs/contact.tsp

**6.** Check out the DLP E2E community to search for solutions, get help, share knowledge and solve problems with fellow engineers and TI experts.

| Changes from Original (June 2015) to A Revision | Page |
|---|---|
| Updated tool folder link for DLP4710 | 14 |
| Updated DLP Pico Chipset table | 10 |
| Updated reference guides and their links | 12 |

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